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WITNESS my hand this
Fourteenth day of February 2005

A handwritten signature in cursive script, appearing to read 'J. Peisker'.

JANENE PEISKER
TEAM LEADER EXAMINATION
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AUSTRALIA
Patents Act 1990
PROVISIONAL SPECIFICATION
FOR A PROVISIONAL PATENT

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Invention Title: Further Improvements In Releaseable Fasteners

The following statement is a description of this invention

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This invention relates to releaseable fasteners. In a first aspect, the invention represents variations of the fastener disclosed in Australian provisional patent application No. 2003902993, the contents of which are imported herein by reference. In a second aspect, this invention is concerned with a different type of fastener.

- 5 Patent application No. 2003902993 disclosed, in broad terms, a releaseable fastener which included:

a longitudinal body including a plurality of ratchet teeth;

a first work engaging member slideably mounted on the longitudinal body;

- 10 a second work engaging member mounted on, or integral with, the longitudinal body; and

a pawl element mounted on the longitudinal body for engagement with the ratchet teeth,

the second work engaging member including means capable of assuming a first position of narrow cross-sectional area and a second position of wide cross-sectional area.

- 15 The purpose of the ratchet teeth on the longitudinal body and the pawl element was to enable the first work engaging member to be pushed along the longitudinal body towards the work to be fastened. The use of ratchet teeth enabled a certain amount of adjustment of the pressure to be applied to the work surface or surfaces.

- 20 It has now been found that the ratchet teeth/pawl combination can be replaced by other arrangements. One non-limiting example is the type of arrangement used for caulking guns, whether manually operated or operated by air or water, for instance. Another example is a screw-based arrangement, which can advance the first working engaging member in small increments. Still another example is an arrangement which provides unidirectional movement of the first working engaging member towards the work to be
- 25 fastened, reverse movement being prevented or impeded by, for instance, means similar to scales used in a larger version on cross-country skis. Such an arrangement may be adapted to a molecular level via nanotechnology. Other examples will be apparent to one skilled in the art. Some of those other arrangements may permit infinite adjustability, rather than discrete adjustability which is found with the use of the ratchet
- 30 teeth and pawl combination.

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It is to be understood that the releasable fastener disclosed in application No. 2003902993 may be provided with a substitute mechanism for the ratchet teeth/pawl combination and that the scope of the invention is to be interpreted accordingly.

For convenience, in connection with embodiments of variations to the original invention in No. 2003902993 are discussed below using the ratchet teeth/pawl combination. However, the scope of the invention is not so limited.

Some of the preferred embodiments illustrated in application 2003902993 were removable in a single assembly from the work surfaces they engaged. One embodiment required the shearing off of part of the fastener before it could be withdrawn from the work surfaces.

Where a releaseable fastener is required for temporarily fastening work surfaces in a "blind" situation, such as the attachment of surface material to the wing of an aircraft, it may be a requirement that the fastener be removable in a single assembly and that no part of the fastener is sheared off so as to be left behind. The variations in the present application are intended to be useful in a "blind" situation.

Accordingly, in its first aspect, this invention provides the releaseable fastener of application No. 2003902993 as broadly defined and as amended above, with the preferred features set out below.

The releaseable fastener is preferably intended for use as a temporary fastener, but may also be employed as a permanent fastener.

The releaseable fastener is preferably made fully or partly of plastic polymer (such as polyurethane) or similar material (but other materials may also be suitable). One or more different materials may be used in combination. For recycling purposes, it is preferred to use a single material, however.

The fastener is shown as circular in cross-section in application No. 2003902993 and below; it is to be understood that the fastener may take any suitable shape. Non limiting examples are cross-sectional shapes which are square or hexagonal. Similarly, elements of the fastener may have cross-sectional shapes other than circular.

Where the fastener includes the ratchet teeth/pawl combination, the longitudinal body preferably carries ratchet teeth for over half its length. In one embodiment, the second work engaging member is integral with or attached to the longitudinal body. In another preferred embodiment, the second work engaging member is separate from the longitudinal body but integral with, or joined, to the first work engaging member.

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The first work engaging member preferably takes the form of a bearing or pressure foot, mounted on the longitudinal body and adapted to be urged towards the work surface or surfaces which are to be trapped between the first work engaging member and the second work engaging member, so as to create pressure on the work surfaces and
 5 compress or hold them together.

The first work engaging member, preferably in the form of the pressure foot, may present a flat profile or a profile of another shape to the work surface it is to contact. The foot may assume any desirable shape. In particular, the foot may be shaped so as to fit into a depression formed in the work surface so that, ultimately, the rivets or other
 10 permanent fasteners will be countersunk into the surface.

The pawl element is preferably mounted on the longitudinal body in engagement with the ratchet teeth. It is preferred that the pawl element is adapted to engage the ratchet teeth so that the pawl element can move in one direction only, namely towards the first and second work engaging members. It is also preferred that the pawl element is
 15 formed integrally with the first work engaging member.

The releaseable fastener may include a guide or locator probe to assist in guiding the releaseable fastener into an aperture in a work surface.

In one embodiment, the first working engaging member, the second work engaging member and the pawl element are made in one piece or in a fixed spatial relationship so that, essentially, the releaseable fastener comprises two parts, the first part being the
 20 longitudinal body having the ratchet teeth and, optionally, a locator probe and the second part being the combination of the first work engaging member, the second work engaging member and the pawl.

In another embodiment, the releaseable fastener of the invention is essentially in three
 25 parts, namely a first part being a longitudinal body including the ratchet teeth and including, by integration or by connection, the second work engaging member, a second part being the first work engaging member combined with the pawl element and a third part located internally of the longitudinal body and optionally including the locator probe.

30 The fastener in the two part embodiment can be suitable for situations where the work surfaces are not widely spaced apart and only a relatively small movement is required to draw them together. The fastener in the three part embodiment can allow more movement and depth capacity and can be suitable for drawing together work surfaces

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which are located more widely apart. The three part embodiment can permit a wider range of adjustment.

The fasteners of the first aspect of the invention, and also the fasteners disclosed in application No. 2003902993, can carry out functions in addition to that of fastening.

- 5 For example, the fastener may include means for attaching one or more elements, such as cables. By way of another example, the fastener may be integrated with an element which needs to be mounted or annexed in a permanent or semi-permanent way to the work surface. Preferably, the attachment or integration takes place in conjunction with the first work engaging member, one embodiment of which is a pressure foot. It will be
10 apparent to one skilled in the art that the attachment or integration can take place via other means on the fastener and that these are within the scope of the invention.

In more detail, one non-limiting example of such a secondary function of the releaseable fastener of the invention is the integration of a cable tie with the first working engaging member. The cable tie may be otherwise a conventional cable tie which encircles a
15 cable or a plurality of cables and which can be drawn up around them by the use of ratchet teeth and a pawl in the normal manner. Similarly, hooks or loops can be attached to, or form part of, the releaseable fastener for mounting artwork or signage on walls or for mounting furniture, such as kitchen cupboards. It will be appreciated by one skilled in the art that there is a myriad of other uses.

- 20 It is preferred that the releaseable fastener of the invention, in any of its embodiments in the present application or in No. 2003902993, is provided mounted in a continuous feeder strip. In the case where the releaseable fasteners are to be mounted by hand, this method of presentation can streamline the selection of fasteners and their manipulation. However, the continuous feeder strip may also be suitable for feeding automatically into
25 a hand tool or robot.

The fasteners may be inserted into a continuous feeder strip. Alternately, the fasteners may be manufactured integrally with a continuous strip. The latter may be particularly suitable where the fasteners are formed by injection moulding; the fasteners may be connected together by a web to form a long strip of fasteners. Fasteners inserted into or
30 manufactured in a continuous strip may be supplied as a cartridge, or in strips of appropriate length, for example, containing 20, 30 or 40 fasteners.

Where a machine tool or robot is used for the fasteners of this invention or for the fasteners of application No. 2003902993, the machine tool or robot may be driven in any suitable manner, but preferably pneumatically.

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The present invention, in connection with the first aspect, also includes a method of fastening work surfaces using the releaseable fastener of the invention, the method including the steps of:

- 5 inserting the second work engaging member into an aperture in the work surfaces;
- causing the means included in the second work engaging member to assume the second position of wide cross-sectional area;
- causing the first work engaging member to advance on the longitudinal body to hold the work surfaces in desired contact between the first and second work engaging members; and
- 10 optionally removing substantially all of the longitudinal body accessible beyond the first work engaging member and the advance element.

In further association with the first aspect of the invention, the present invention provides a method of removing the releaseable fastener of the invention from work surfaces fastened by the releaseable fastener, the method including the steps of:

- 15 causing the second work engaging member to assume the first position of narrow cross-sectional area; and
- withdrawing the releasable fastener from the aperture in the work surfaces.

In order to cause the second work engaging member to assume the first position, in some embodiments it may be necessary to disengage the pawl element from the ratchet teeth, for example, in the two-part embodiment referred to above. This may involve breaking off part of the pawl element. In other cases, it may not be necessary to disturb the engagement of the pawl element with the ratchet teeth. Further details of these arrangements are illustrated in the accompanying drawings and described below.

25 The second aspect of this invention is concerned with variations of the "Fixing and Release Systems" invention, first disclosed in international patent application No. PCT/AU99/00185 (WO99/47819). The contents of that specification are incorporated herein by reference.

In a broad form, the Fixing and Release Systems invention as applicable to the second aspect of the present invention disclosed:

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a connecting means adapted to releasably fix a first element and a second element, the connecting means including a locking means movable by remote activation means between a locked position in which the first element is locked to the second element and an unlocked position in which the first element is released from the second element, characterised in that there is no permanent material connection (as defined in the specification) between the connecting means and the remote activation means.

In a preferred embodiment of WO99/47819, the locking means is moveable in a deformable channel and in the first position the locking means prevents deformation of the channel in the region of the locking means

In the variations in the second aspect of this present invention, the fastener is particular useful as a strip fastener. In this variation, the locking element is one, but preferably more than one, rotatable element adapted to be rotatable within the deformable channel, the axis of rotation being transverse to the longitudinal axis of the channel. The rotatable locking element is designed to present a wide dimension towards the mouth of the channel when the fastener is in the locked position and a narrow dimension towards the mouth of the channel when in the unlocked position. The mouth of the channel is prevented from deforming inwardly when the locking element locks it via the wide dimension. The mouth of the channel can deflect inwardly when the locking element presents the narrow dimension towards the mouth of the channel.

Preferably, the locking element is moveable by a magnet or electromagnet from the locked to the unlocked position. Even more preferably, there is a plurality of locking elements side by side with each other and each uses magnetic means to maintain alignment with its neighbour. The purpose of this is to enable each "set" of rotatable locking element to rotate in unison, so that all present their narrow edges to the mouth of the channel at the same time or, conversely, all present their wide edges to the mouth of the channel at the same time.

In a simple version of this type of fastener, a magnet can be "swiped" along a line of locking elements to cause them to rotate through 180°, to either lock or unlock. Reversing polarity of the magnet and swiping it again will cause the locking elements to rotate through 180° to regain their original position.

The rotatable elements may take any desired shape, provided they perform the desired function of preventing inward deflection of the relevant part of the walls (eg, the mouth) of the channel when in the locked position. As one example, the rotatable locking element may resemble a wedge in side elevation and a circle or square in plan view. As

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another example, the locking element may itself be two or more rotatable elements with the shape of each in side elevation being constant, eg, a rectangle. In this latter example, the rotatable elements cause a bar or similar means to be raised or lowered. When the rotatable elements are caused to rotate in one direction, the bar is elevated to
 5 prevent deflection of the relevant part of the channel walls. When the rotatable elements are rotated further or in the reverse direction, the bar is caused to descend.

Other embodiments of the locking means are possible and will be apparent to one skilled in the art.

The invention in its various aspects will now be described in connection with certain
 10 non-limiting examples described in the drawings, in which :

Figure 1 shows in side elevation, partly in section, a first embodiment of the fastener of the invention in the first aspect, inserted into an aperture in work surfaces;

Figure 2 is a cross-sectional view taken along the lines 2-2 of Figure 1;

15 Figure 3 is a cross-sectional view taken along the lines 3-3 of Figure 1;

Figure 4 is a cross-sectional view taken along the line 4-4 of Figure 1;

Figure 5 shows a fastener similar to that in Figure 1 after first insertion into an aperture in work surfaces;

20 Figure 6 is part of a continuous feeder strip from which the fastener in Figure 5 has been taken for insertion;

Figure 7 shows the fastener of Figure 5 during the process of drawing the work surfaces together;

Figure 8 shows a further progression of operation of the fastener in Figures 5 and 7, with the work surfaces fastened and part of the fastener having been detached;

25 Figure 9 shows the first part of the removal process of the embodiment in Figures 5, 7 and 8;

Figure 10 shows the final part of the removal process of the fastener in Figure 9;

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Figure 11 shows in side elevation, partly in section, a second embodiment of the fastener of the invention in the first aspect, after initial insertion into apertures in the work surfaces;

5 Figure 12 shows the fastener of Figure 11 after the fastener has been used to fasten the work surfaces together and part of the fastener has been detached;

Figures 13, 14, 15 and 16 show in sequence the progress of insertion of the embodiment in Figures 11 and 12, with Figure 13 being essentially the same as Figure 11 and Figure 12 being included in Figure 16;

Figures 17 and 18 show in sequence the removal of the Figure 12 embodiment;

10 Figure 19 shows in side elevation, partly in section, a variation of the Figure 12 embodiment, integrated with a cable tie;

Figure 20 shows the embodiment of Figure 19 with the cable tie drawn around a cable (not shown) and locked into position;

15 Figure 21 shows an embodiment of the second aspect of the invention, in side elevation;

Figure 22 shows the Figure 21 embodiment in end elevation;

Figure 23 shows the Figure 21 embodiment in top plan view;

Figure 24 shows the Figure 21 embodiment in perspective view;

20 Figure 25 shows the Figure 21 embodiment in exploded view (perspective, from above); and

Figure 26 shows the Figure 21 embodiment in exploded view (perspective, from below),

In connection with Figures 1 to 20, the same parts as in application No. 2003902993 will be given the same numerals.

25 Referring first to Figures 1 to 4, fastener 80 is intended for manual use and is shown inserted in aperture 12 in first work piece 14 and aperture 16 in second work piece 18. Normally at this stage, second work piece 18 may be spaced from first work piece 14 as shown in dotted outline in Figure 1. (Figures 5 and 7 show the normal progress in drawing work pieces 14 and 18 together).

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Fastener 80 has longitudinal body 82 which carries several ratchet teeth 22. At the end of fastener 80, intended for insertion in apertures 12 and 16, is a probe 84 to help with alignment.

Fastener 80 has, moulded in one piece, first work engaging member 86 (in the form of a pressure foot), pawl element 88 and second work engaging member 90. Pawl element 88 engages ratchet teeth 22 through ratchet lock 92.

In this embodiment, second work engaging member 90 is made of four leaves 94. In Figure 1 these are shown in the first position of narrow cross-sectional area, encircling part of longitudinal body 82. Also as shown in Figure 1, at their base, leaves 94 are attached by a narrow strip of material 96 to foot 86. The purpose of this is described below. Narrow strip of material 96 also includes a second ratchet lock 98 for engaging teeth 22.

Probe 84, which is located at one end of longitudinal body 82, tapers out to expanded part 100. When longitudinal body 82 is moved upwardly (with reference to the orientation shown in Figure 1), expanded part 100 forces apart leaves 94, so that second work engaging means 90 can assume the second position of wide cross-sectional area. For this to occur, work pieces 14 and 18 need to be in the position shown in hard outline in Figure 1, otherwise leaves 98 are not able to be expanded outwardly by part 100. Work pieces 14 and 18 may be brought together by, for example, downward pressure on foot 86 and/or by drawing longitudinal body 82 upwardly.

Figure 2, which is a cross-sectional view taken along the lines 2-2 of Figure 1, approximately through the interface between work surfaces 14 and 18 (and omitting those work surfaces), shows the narrow strip of material 96 and the second ratchet lock 98. It will be seen that there are four second ratchet locks 98 and that these correspond to four narrow strips of material 96. In contrast, in this embodiment, ratchet lock 92 is not provided in segments, but is continuous to encircle the relevant tooth 22.

In Figure 3, it can be seen that leaves 94 are provided with a gap 95 between neighbouring leaves. It may be desired to provide leaves 94 with a narrower gap, or no discernible gap. In Figure 3, the location of second ratchet locks 98 and narrow strips of material 96 are shown, but these are to be regarded as in dotted outline, since they are not in fact visible in the cross-section.

Whereas the embodiment in Figures 1 to 4 is suitable for manual insertion, the slight variation shown in Figures 5 and 7 to 10 is intended to be useful for insertion by a hand

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tool or tool powered, for example, by air. It may be noticed that longitudinal body 82 in Figure 1 is somewhat longer than that in Figure 5 and Figures 7 to 8.

With reference to Figures 5 and 6, for insertion of fastener 80 into apertures 12 and 16, and in order to fasten work pieces 14 and 18, fastener 80 is fed from continuous feeder strip 102 (Figure 6). It is to be noted that strip 102 is shown as attaching fasteners 80 near the "head" of each fastener 80. It is within the scope of the invention that the continuous feeder strip 102 is joined to some other part of fastener 80, for example, foot 86 or pawl element 88. Fastener 80 is pushed into apertures 12 and 16.

Work pieces 14 and 18 are caused to move together to the position shown in Figure 7, for example by pressure on foot 86, by advancing pawl element 88 down ratchet teeth 22. When fastener 80 is moved in the direction of arrow 106 in Figure 7, expanded part 100 of longitudinal body 82 causes leaves 94 to flare out as illustrated, fastening work pieces 14 and 18 together. At this stage, ratchet locks 92 and second ratchet lock 98 are engaged with teeth 22.

The part of longitudinal body 82 beyond pawl element 88 can now be sheared off by a suitable cutting means (partially shown at 108), as shown in Figure 8. The result is a neat fastener which can hold the work pieces together while riveting or other permanent fastening takes place in nearby rivet holes (not shown). This can be particularly useful if the rivets are to be inserted by robot, since the sheared-off fastener presents a low profile and does not impede robotic operation.

If it is desired to remove fastener 80, the procedure shown in Figures 9 and 10 is followed. As shown in Figure 9, the remaining part of longitudinal body 82 is pushed in the direction of arrow 110. In order to do this, a tool (not shown), may be used to grip the combined pawl/foot body by using channel 104 and punch longitudinal body 82 with sufficient force to break off ratchet lock 92. Fragments of ratchet lock 92 are shown symbolically in Figure 9, it being recalled that in fact ratchet lock 92 represents a circumscribing impingement. Second ratchet locks 98, however, remain in engagement with teeth 22. After longitudinal body 82 has been pushed away from pawl element 88 sufficiently for leaves 94 to return to their closed position, fastener 80 may be withdrawn from work pieces 14 and 18 as shown in Figure 10. Because of the engagement between second ratchet lock 98 and teeth 22, pulling fastener in the direction of arrow 112 in Figure 10 will result in withdrawal of the remaining part of fastener 80 from apertures 12 and 16.

The second embodiment in Figures 11 to 18 will now be described. Looking first at Figure 11, fastener 120 has longitudinal body 122 carrying several ratchet teeth 22. In

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this embodiment, longitudinal body 122 is a cylinder. Located within the cylinder 122 is plunger 114 which has at one end continuous strip 116, fulfilling the same function as strip 102 in the previous embodiment. At the other end of plunger 114 is probe 118. Probe 118, like probe 84, has an expanded part 124. Plunger 114 is shown in Figures 11
 5 and 12 as having shoulders 126, neck 128 and ramp 130 as well as stop 132. At least in the region of ramp 130, plunger 114 is sufficiently resilient to enable ramp 130 to pass through aperture 134 into longitudinal body 122. Because of the slope between neck 128 and the widest part of ramp 132, plunger 114 can be moved from the position shown in Figure 11 shown in Figure 12 relatively easily. However, because of contact
 10 between the widest part of ramp 130 and shoulder 126, more force is required to reverse the movement of plunger 114.

In the Figure 11 embodiment, first work engaging member 86 and pawl element 88 are basically the same as in the Figure 1 embodiment and consequently the same numerals have been used. The difference between the respective embodiments in this regard is
 15 that, in the Figure 11 embodiment, there are essentially three parts - plunger 114, longitudinal body 122 and foot 86 (combined with pawl element 88). In the Figure 1 embodiment, there are two parts, namely longitudinal body 82 and foot 86 (combined with pawl element 88 and second work engaging means 90).

In the Figure 11 embodiment, second work engaging means 136 is formed with leaves
 20 138 as in the previous embodiment, but is part of, or joined to, longitudinal body 122. Expanded part 124 of probe 118 is used to open up leaves 138 to the second position of wide cross-sectional area.

Turning to the sequence of insertion shown in Figures 13 to 16, in Figure 13 work pieces 14 and 18 are shown in a wider spaced apart relationship than in Figure 5.
 25 Fastener 120 is inserted in apertures 12 and 16 by moving fastener 120 in the direction of arrow 140. As is the case of the previous embodiment, insertion takes place by hand tool or robot, using fasteners mounted on a continuous feeder strip 116 like that shown in Figure 6 as 102.

Next, as shown in Figure 14, plunger 114 is moved in the direction of arrow 142 in
 30 Figure 14. In doing so, ramp 130 is drawn through aperture 134 to the position shown in more detail in Figure 12. At the same time, expanded part 124 of probe 118 forces leaves 138 apart.

Continued tension on fastener 120 in the direction of arrow 142, combined with advancement of pawl element 88 down ratchet teeth 22, draws work pieces 14 and 18
 35 together as shown in Figure 15. At this point the superfluous part of fastener 120 is

To remove fastener 120, refer to the procedure shown in Figures 17 and 18. A tool (not shown) is used to punch the remaining part of plunger 114 in the direction shown by arrow 144 with sufficient force to fracture ramp 30 against the narrow portion of aperture 134. Then expanded part 124 of probe 118 can be moved away from leaves 138, which accordingly can collapse. Ratchet lock 92 in teeth 22 enables fastener 120 to be withdrawn in a single piece as shown by arrow 146 in Figure 18.

As is the case with conventional cable ties, arm 148 carries teeth 152 and arm 150
15 includes complementary teeth 154 in passage 156.

20 It will be appreciated that, instead of the cable tie, another type of fastening element could be used, such as a loop (for hanging pictures for example) or a cup hook. Alternately, fastener 120 could be integrated with any other type of product which it was desired to annex or affix to a work piece.

Fastener 160 has three rotatable locking elements 158 mounted in channel 162. Each locking element 158 can rotate about axis 164. Each locking element 158 is generally wedged-shaped in side elevation, having a thick edge 166 opposite a thin edge 168 (refer Figure 28). Each locking element 158 includes a magnet 170.

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from moving out of engagement from protrusion 176, since upper part 172 of arm 174 is prevented from deflecting inwardly, because of the presence of the thick edges 166 of locking elements 158.

In order to release the engagement by protrusion 176 with the element (not shown), it is
 5 necessary to rotate locking elements 158 so that the thin edges 168 are situated at the upper part 172 of channel 162. To achieve this, a simple bar magnet may be swiped along base 178 or in its region. Depending on polarity of the magnet, locking elements 158 will rotate through 180° either to the right or to the left. A magnet 170 on each
 10 locking element 158 ensures that all locking elements rotate in unison. When thin edges 168 lie between upper parts 172, there is room for deflection and protrusion 176 may no longer engage the element (not shown).

Reversing the polarity of the bar magnet and swiping it again will cause the locking elements 158 to turn to their original position.

As will be appreciated by one skilled in the art, rotation of locking elements 158 may be
 15 achieved by other means, for example by use of a electromagnetic field. In another embodiment (not shown), locking elements 158 may have consistent thickness throughout, rather than being wedge type and shaped as shown in Figures 25 and 26. Instead, a locking bar may be attached to the rotatable locking element. Rotation of the
 20 elements can be used to raise the locking bar between upper parts 172 of arms 174, preventing inward deflection. Further rotation of the locking elements can return the locking bar to the original unlocked position.

As explained in further detail in patent application No. W099/47819, the locking and unlocking may be effected by remote activation, with no material connection made
 25 between the actuating means, such as the magnet, and the locking elements. It is within the scope of the invention, however, that hard wiring, or other material connection, may also be used in the case of the second aspect of the invention.

It will also be appreciated by one skilled in the art that other embodiments are available for both the first and second aspects of the invention and that these are within the scope of the invention.

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Dated this 4th day of February 2004.

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Telezygology Inc
By its Patent Attorneys
Chrysiliou Law

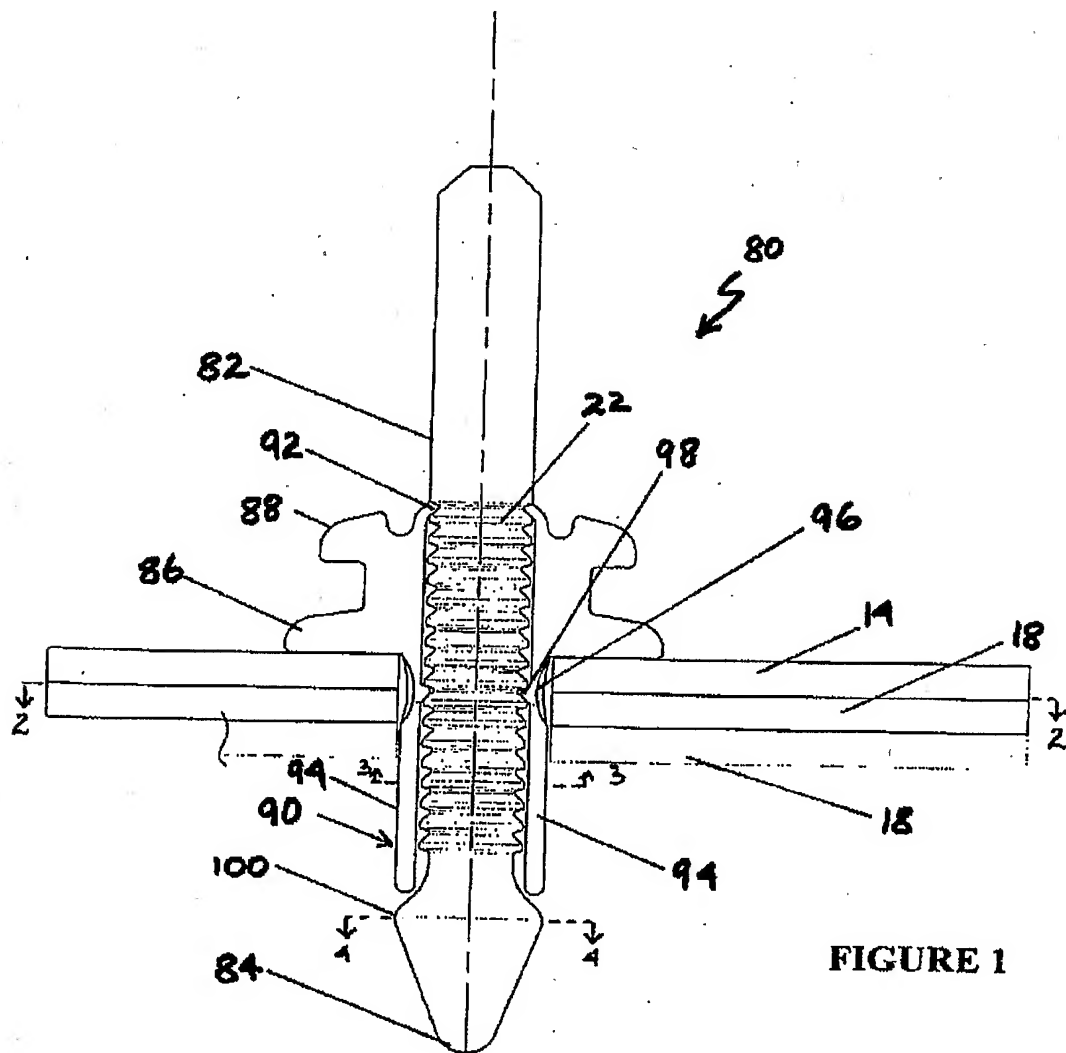


FIGURE 1

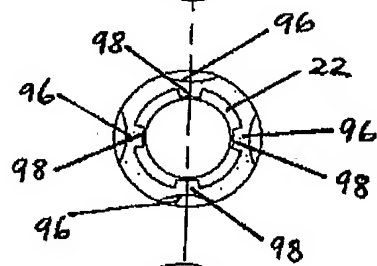


FIGURE 2

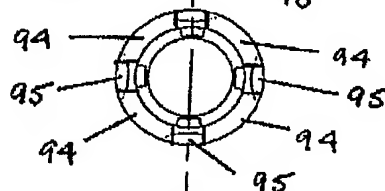
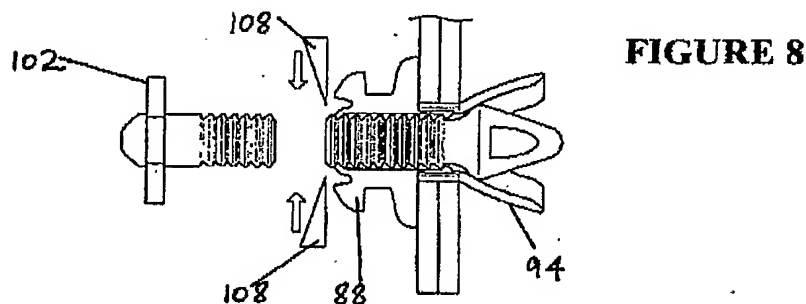
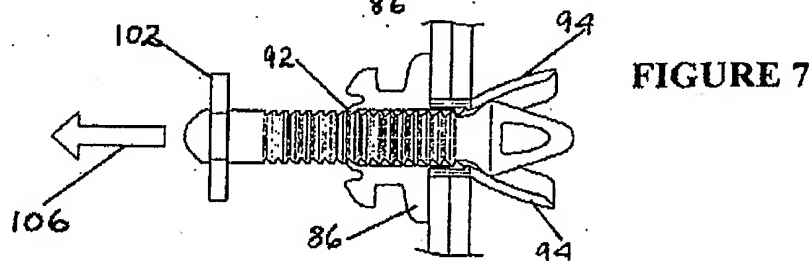
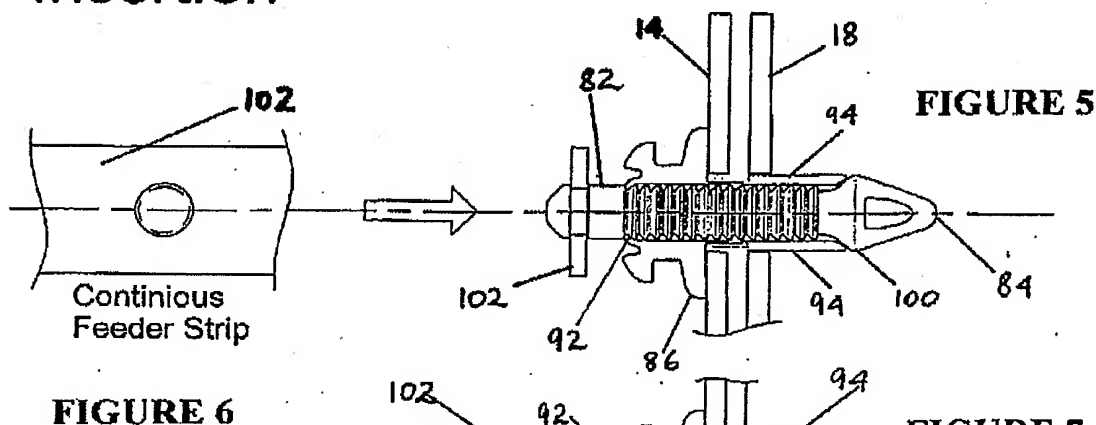


FIGURE 3

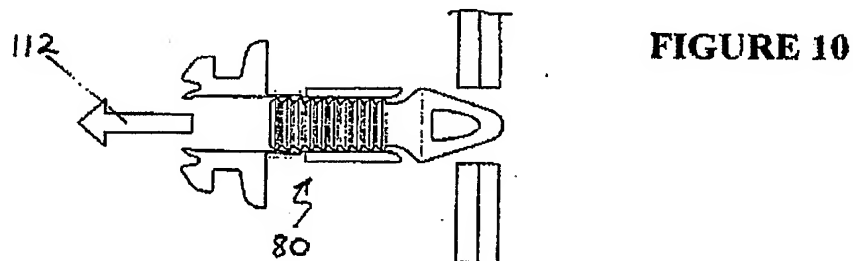
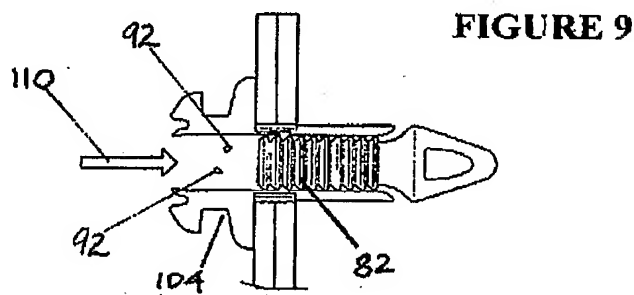


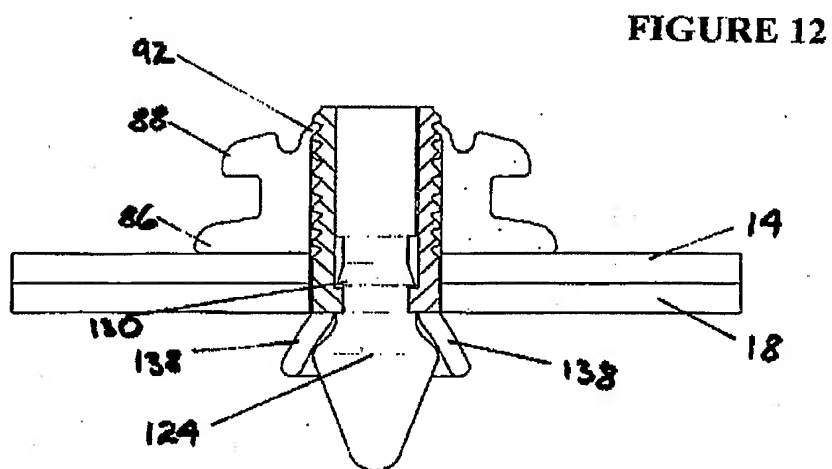
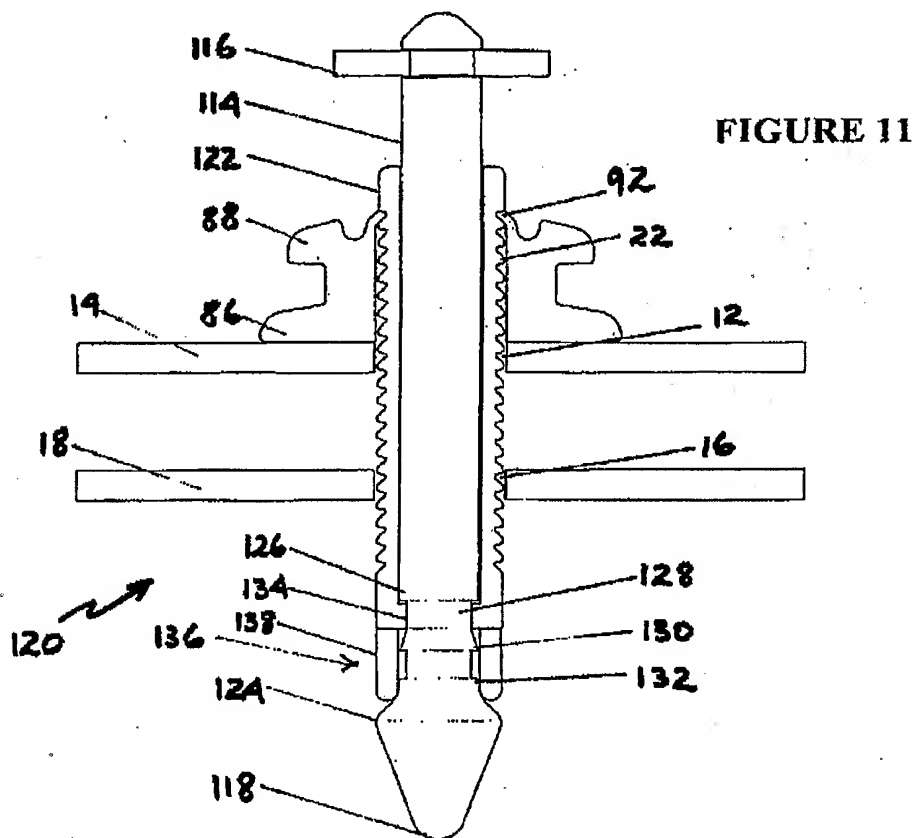
FIGURE 4

Insertion



Removal





Insertion

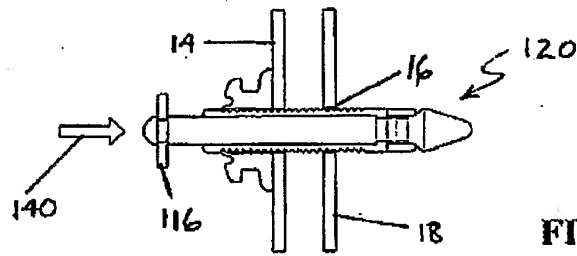


FIGURE 13

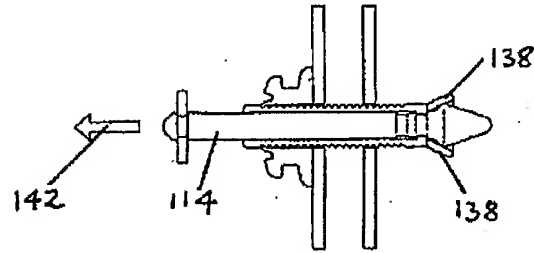


FIGURE 14

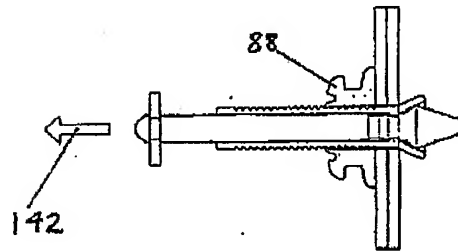


FIGURE 15

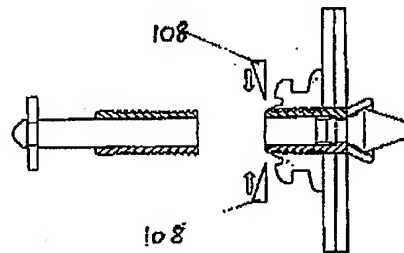


FIGURE 16

Removal

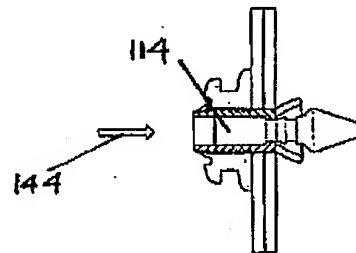


FIGURE 17

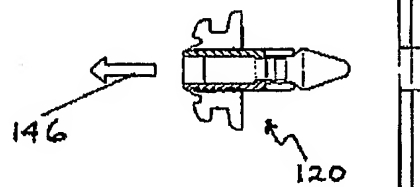


FIGURE 18

FIGURE 19

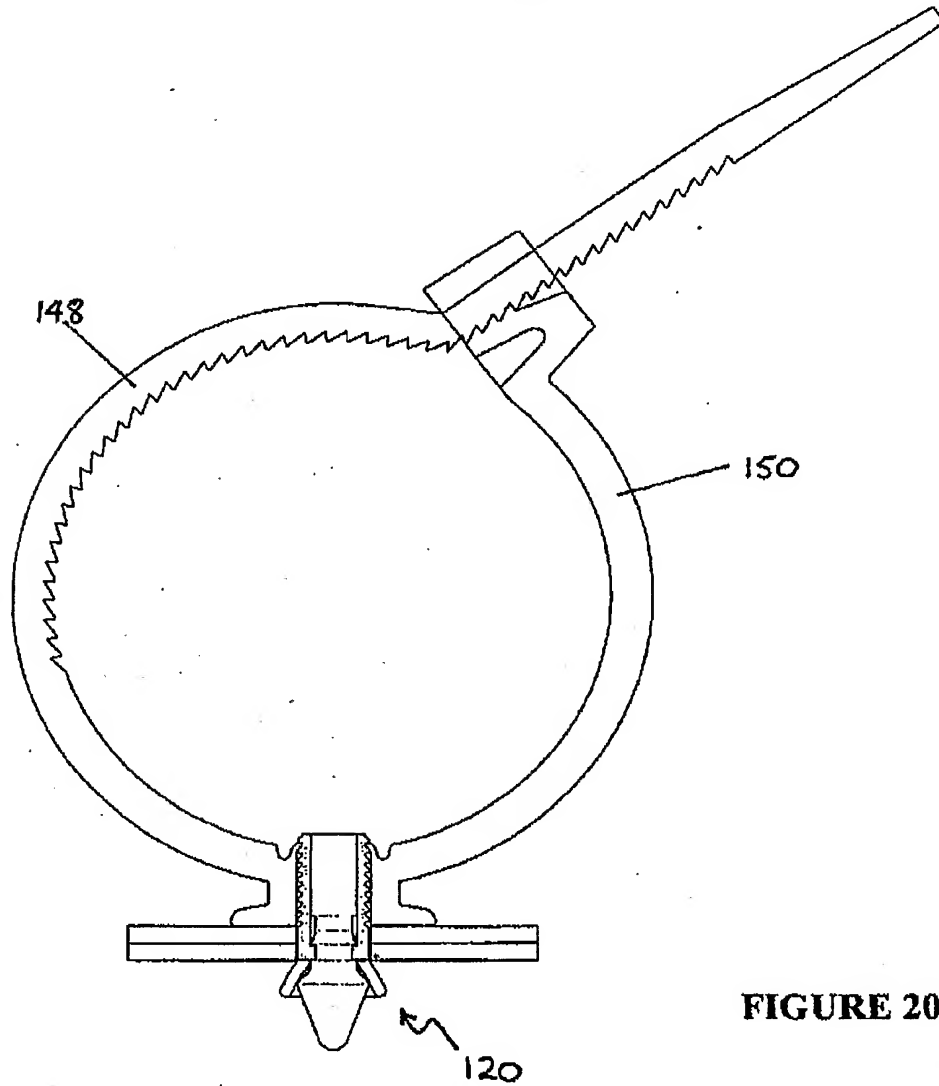
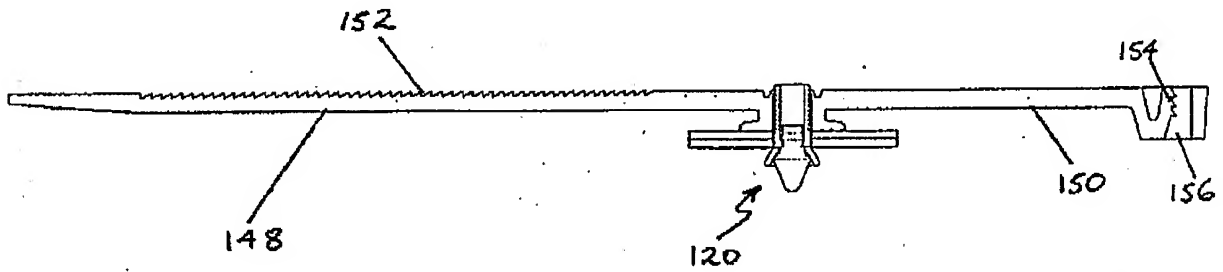


FIGURE 20

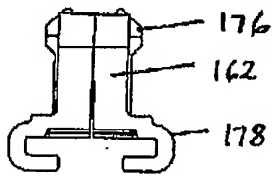


FIGURE 22

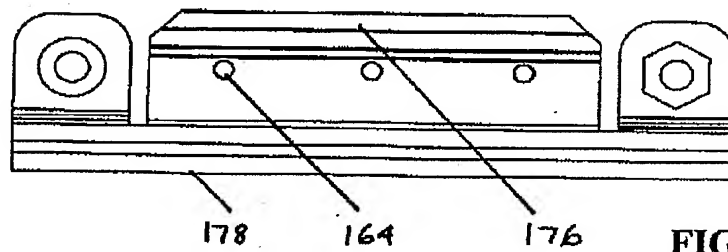


FIGURE 21

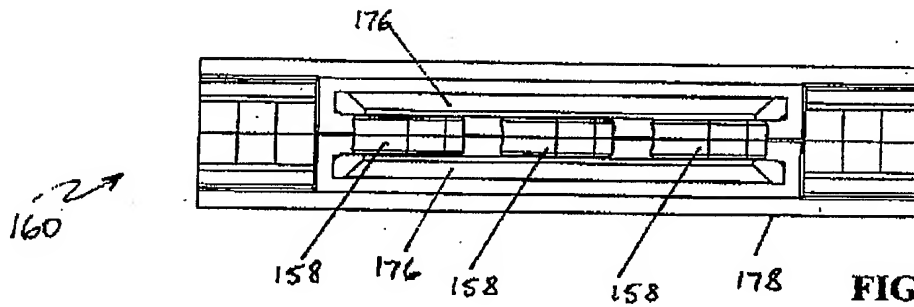


FIGURE 23

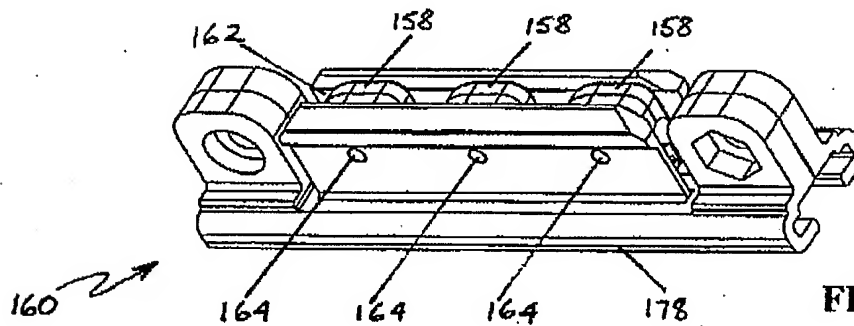


FIGURE 24

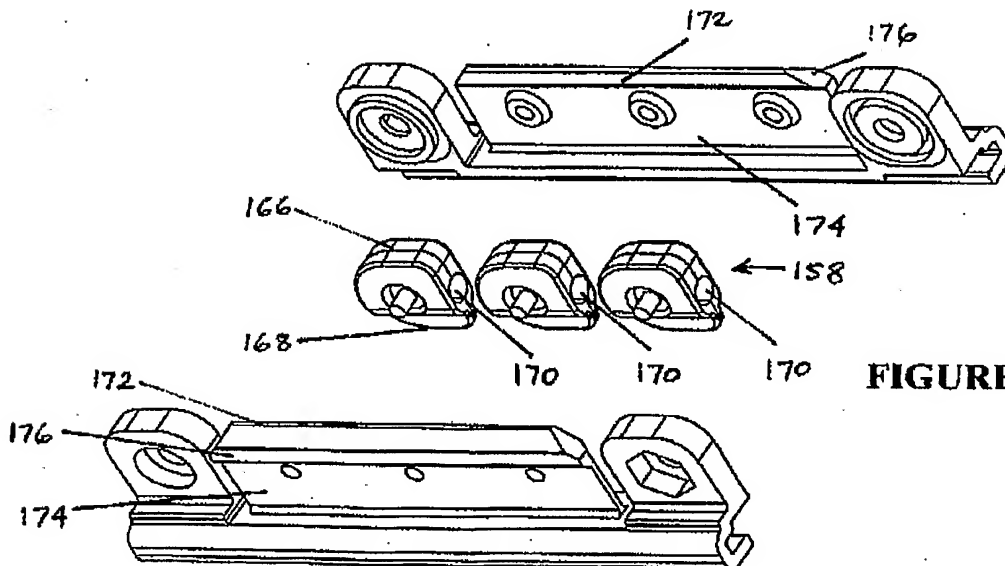


FIGURE 25

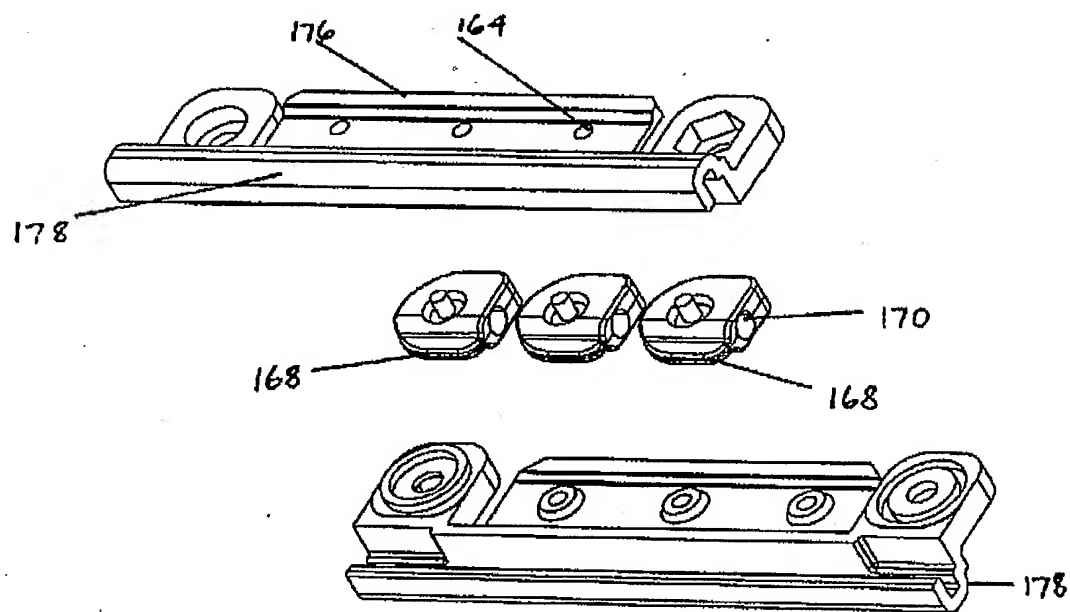


FIGURE 26